REMARKS

Claims 1, 2 and 8-17 are pending in this application, of which claim 1 has been amended and claims 8-17 have been added. Claims 3-7 have been cancelled in this Response.

The amendment of claims 1, 8, 9, 12 and 13 are supported at page 7, line 32 to page 8, line 4. Claims 10, 11, 14 and 15 are supported by original claims 4, 6, 5 and 7, respectively. Claims 16 and 17 are supported at page 4, lines 22-24.

(1) Claims 1-2 were rejected under 35 U.S.C. §102(a)/(b) as being anticipated by Fukushima et al. (Molecular Ordering of Organic Molten Salts Triggered by Single-Walled Carbon Nanotubes" Science, 27 June 2003, vol. 300, pages 2072-74).

The authors of Fukushima et al. overlap with the inventors of the present invention.

Although the Examiner states that claim 2 is anticipated by Fukushima et al., the disclosed gel does not include a polymer. Please see the paragraph bridging between the middle column and the right column at page 2072. Fukushima et al. teach that "we synthesized a bulky gel of a polymerizable ionic liquid.... (the left column at page 2074)." The polymerizable ionic liquid is different from the claimed "polymer." In the present invention, the claimed "polymer" is included separately from the ionic liquid.

Because the gel disclosed by Fukushima et al. does not include a polymer, it does not have enough mechanical strength to be used as a material for an electrode layer in an actuator. Fukushima et al. disclose at page 2074, the middle col., lines 9-15 that the dynamic hardness (DHT_{115}) of a polymer/SWNT composite obtained from the polymerizable gel of $ABMIPF_6$ and SWNTs reached 0.074, exhibiting about 400% increase compared with the dynamic hardness (DHT_{115}) of a reference polymer formed solely from $ABMIPF_6$. Please see "26" in "References and Notes" at page 2074 of Fukushima et al. However, this value is still lower than 1/100 of the dynamic hardness of general polymers, and is not sufficient to use the material as an actuator electrode. Accordingly, the material disclosed by Fukushima et al. cannot be practically used in actuators.

Applicants also submit that claims 8 and 9 are allowable standing alone. Claims 8 and 9 recite specific polymers. Because the specific polymer is added in the conductor material or the electrode layer, satisfactory mechanical strength and other desirable properties can be obtained in the invention.

(2) Claims 4-7 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fukushima et al. and further in view of Baughman et al. (U.S. Patent No. 6,555,945) or Smela ("Conjugated Polymer Actuators for Biomedical Applications" Adv. Mater., 17 March 2003, vol. 15, pages

481-494) or Jager et al. ('Microfabricating Conjugated Polymer Actuators" Science, 24 November 2000, pages 1540-1 545).

Claims 4-7 have been rewritten as claims 10, 14, 11 and 15, respectively. These newly added claims have incorporated the limitation that the electrode layers and the ion-conductive layer are prepared from the same type of ionic liquid and polymer. In Examples of the present invention, all of the electrode layers and the ion-conductive layer included $BMIPF_6$ and PVDF. Please see page 14 of the specification.

In claims 10, 14, 11 and 15, the electrode layers and the ion-conductive layer are prepared from the same type of ionic liquid and polymer. In the actuator element of the invention, the ion-conductive layer and the electrode layer are closely adhered to each other in such a manner that the interface is not clear and the layers (e.g., the ion-conductive layer and the electrode layers) form a harmonious whole, as if the actuator element has a structure in which carbon nanotubes are localized in the vicinity of the front and back surfaces of a film or sheet uniformly formed from an ionic liquid and a polymer. The actuator element of the present invention improves durability as an actuator operable in an air.

The Examiner states that Baughman et al., Smela or Jager et al. teach the method of making various actuator that utilize gel polymer with electrolytes. However, none of the

references teaches improving the adhesion between the electrode layers and the ion-conductive layer to increase the durability. Also, Fukushima et al. do not disclose the claimed "polymer" as explained above. Thus, claims 10, 14, 11 and 15 are not obvious over the cited references.

(3) Please note that one skilled in the art is not motivated to combine Fukushima et al. with Baughman et al., Smela or Jager et al. Baughman et al. discloses, in col. 4, lines 28 to 54 and col. 17, lines 41 to 61, an actuator element that can be operated in an aqueous salt solution of an alkali metal or like inorganic salt, and therefore, the technical field of Baughman et al. is different from the present invention operable in air. In this respect, please also see newly add claims 16 and 17. As an example of a solid electrolyte, Baughman et al. disclose, in col. 18, lines 11 to 44, an ion-conductive layer using a solvent such as propylene carbonate. However, in this structure, the solvent such as propylene carbonate eventually evaporates, and therefore, a sufficiently long lifetime as an actuator element operable in air cannot be obtained. This is clear from the specification at page 3, lines 6 to 10, describing that use of high-boiling-point organic solvents such as propylene carbonate, in place of water, cause problems because their conductivity and response are less than water.

Example 10, in col. 38 of Baughman et al. discloses an air-operated actuator element wherein H_3PO_4 containing PVA is used as an ion-conductive layer, and a nanotube paper is used as an electrode layer. This actuator element is fabricated by wetting one surface of the nanotube

paper and pressing it onto the ion-conductive layer by hand. Also in this structure, when water evaporates, the electrode layer and the ion-conductive layer will be delaminated and a sufficiently long lifetime as an air-operated actuator element cannot be obtained. Baughman et al. does not suggest or teach increasing the adhesion between the electrode layer and the ion-conductive layer.

A microactuator disclosed by Jager et al. is obtained by electrochemically depositing a conducting polymer on a metallic layer. The microactuator is bent when a voltage is applied to the counter electrode in a liquid electrolyte. Accordingly, the microactuator of Jager et al. is in a technical field different from and irrelevant to the actuator element of the present invention, which can be operated in air. In this respect, please also see newly add claims 16 and 17.

Smela merely discloses the possibility of the use of an ionic liquid, but one skilled in the art is not motivated to modify Fukushima et al. in view of Smela in order to obtain the present invention.

(4) In view of the aforementioned amendments and accompanying remarks, Applicants submit that that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned representative at the telephone number indicated below to arrange for an interview to expedite the disposition of this case. If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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